Abdulla Aljunibi

TURBINE ENGINE IGNITION SYSTEMS

Since turbine ignition systems are operated mostly for:

- a brief period during the engine starting cycle

The turbine engine ignition system does not need to be:

- timed to spark during an exact point in the operational cycle

It is used to ignite the:

- fuel in the combustor and then it is switched off

Other modes of turbine ignition system operation, such as:

- continuous ignition that is used at a lower voltage and energy level, are used for certain flight conditions

Continuous ignition is used in case the engine were to :

- flame out

This ignition could:

- relight the fuel and keep the engine from stopping

Examples of critical flight modes that use continuous ignition are:

- takeoff
- landing
- abnormal and emergency situations

Most gas turbine engines are equipped with a:

- high energy, capacitor type ignition system and are air cooled by fan airflow.

Cooling the ignition plug

Fan air is ducted to the:

- exciter box

and then flows around the:

- igniter lead and surrounds the igniter before flowing back into the nacelle area.

Cooling is important when :

- continuous ignition is used for some extended period of time

Gas turbine engines may be equipped with an:

- electronic type ignition system

which is a variation of the:

- simpler capacitor type system

simpler capacitor type system

The typical turbine engine is equipped with a:
- capacitor type, or capacitor discharge

ignition system consisting of :
- two identical independent ignition units
- operating from a common low voltage (DC) electrical power source: the aircraft battery, 115AC, or its permanent magnet generator

The generator is turned directly by the:
- engine through the accessory gear box and produces power any time the engine is turning

The fuel in turbine engines can be:
- ignited readily in ideal atmospheric conditions

but since they often operate in the low temperatures of high altitudes,:
- it is imperative that the system be capable of supplying a high heat intensity spark.

a high voltage is supplied to arc across a wide igniter spark gap, providing :
- the ignition system with a high degree of reliability under widely varying conditions

The condensation:
- altitude
- atmospheric pressure
- temperature
- fuel vaporization
- input voltage

typical ignition system

A typical ignition system includes:
- two exciter units
- two transformers
- two intermediate ignition leads
- two high tension leads

as a safety factor, the ignition system is actually a :
- dual system designed to fire two igniter plugs.

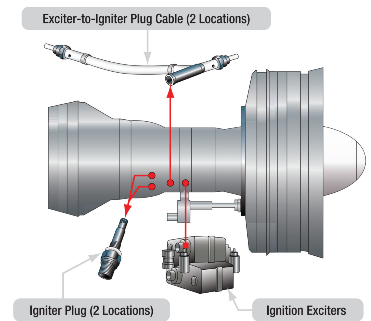

Figure 13-13. Turbine ignition system components.

typical capacitor type turbine ignition system

A 24 volt DC input voltage is supplied to the:
- input receptacle of the exciter unit.

An exciter unit in a gas turbine engine is
- part of the ignition system.
- It generates high-voltage electrical pulses to ignite the fuel-air mixture during engine startup. The unit typically converts the aircrafts electrical power (AC or DC) into a high-energy spark
- using capacitors and transformers.
- This spark is delivered to the igniter plugs, ensuring reliable engine ignition, especially in adverse conditions like high altitude or cold weather.

Before the electrical energy reaches the exciter unit, it passes through a:
- filter that prevents noise voltage from being induced into the aircraft electrical system.

The low voltage input power operates a:
- DC motor that drives one multilobe cam and one single lobe cam.

At the same time, input power is supplied to a:
- set of breaker points that are actuated by the multilobe cam

From the breaker points:
- a rapidly interrupted current is delivered to an auto transformer

When the breaker closes, :
- the flow of current through the primary winding of the transformer establishes a magnetic field

When the breaker opens:
- the flow of current stops
- and the collapse of the field induces a voltage in the secondary of the transformer

This voltage causes a pulse of current to :
- flow into the storage capacitor through the rectifier, which limits the flow to a single direction

With repeated pulses,:
- the storage capacitor assumes a charge, up to a maximum of approximately 4 joules

The storage capacitor is connected to the:
- spark igniter through the triggering transformer and a contactor, normally open.

When the charge on the capacitor has built up:
- the contactor is closed by the mechanical action of the single lobe cam.

A portion of the charge flows through the:
- primary of the triggering transformer and the capacitor connected with it

This current induces a high voltage in the secondary, which:
- ionizes the gap at the spark igniter

When the spark igniter is made conductive

- the storage capacitor discharges the remainder of its accumulated energy along with the charge
- from the capacitor in series with the primary of the triggering transformer

The spark rate at the spark igniter varies in :

- proportion to the voltage of the DC power supply that affects the rpm of the motor.

However:

since both cams are geared to the same shaft, :

- the storage capacitor always accumulates its store of energy from the same number of pulses before discharge.

The employment of the high frequency triggering transformer, with a low reactance secondary winding, :

- holds the time duration of the discharge to a minimum.

This concentration of maximum energy in minimum time achieves an:

- optimum spark for ignition purposes,
- capable of blasting carbon deposits and vaporizing globules of fuel.

All high voltage in the triggering circuits is completely isolated from the :

- primary circuits

The complete exciter is :

- hermetically sealed,
- protecting all components from adverse operating conditions,
- eliminating the possibility of flashover at altitude due to pressure change.

This also ensures:

- shielding against leakage of high frequency voltage interfering with the radio reception of the aircraft

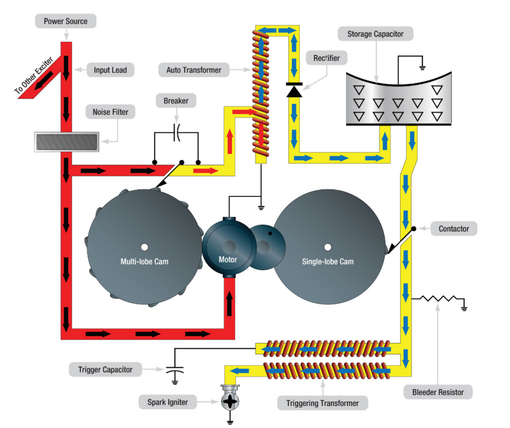

Figure 13-14. Capacitor-type ignition system schematic.

CAPACITOR DISCHARGE EXCITER UNIT

This capacitor type system provides ignition for:
- turbine engines.

Like other turbine ignition systems, it is required only for:
- starting the engine;
- once combustion has begun, the flame is continuous.

The energy is stored in:
- capacitors

Each discharge circuit incorporates:
- two storage capacitors

both are located in the:
- exciter unit

The voltage across these capacitors is stepped up by:
- transformer units

At the instant of igniter plug firing, the resistance of the gap is:
- lowered sufficiently to permit the larger capacitor to discharge across the gap.

The discharge of the second capacitor is :
- of low voltage, but of very high energy

The result is a:
- spark of great heat intensity,
- capable of not only igniting abnormal fuel mixtures
- but also burning away any foreign deposits on the plug electrodes

The exciter is a :
- dual unit that produces sparks at each of the two igniter plugs

A continuous series of sparks is produced until the engine:
- starts

The power is then:
- cut off, and the plugs do not fire while the engine is operating other than on continuous ignition for certain flight conditions.

IGNITER PLUGS

Its electrode must be capable of withstanding a:

- current of much higher energy than the electrode of a conventional spark plug

This high energy current can quickly cause;

- electrode erosion,

but the short periods of operation:

- minimize this aspect of igniter maintenance

The electrode gap of the typical igniter plug is:

- designed much larger than that of a spark plug since the operating pressures are much lower and the spark can arc more easily than in a spark plug

electrode fouling, common to the spark plug, is :

- minimized by the heat of the high intensity spark

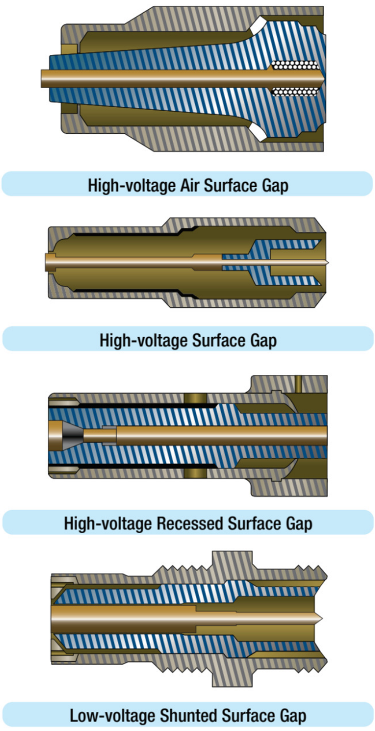

Figure 13-16. Ignitor plugs.

cutaway of a typical annular gap igniter plug

sometimes referred to as a long reach igniter because it :

- projects slightly into the combustion chamber liner to produce a more effective spark

constrained gap plug

is used in:

- some types of turbine engines

It operates at a :

- much cooler temperature because it does not project into the combustion chamber liner

This is possible because:

- the spark does not remain close to the plug

but :

- arcs beyond the face of the combustion chamber liner.

IGNITION SYSTEM INSPECTION AND MAINTENANCE

Maintenance ofthe typical turbine engine ignition system consists primarily of

- inspection
- test
- troubleshooting
- removal
- installation

Inspection

Inspection of the ignition system normally includes the following:

1, Ignition lead terminal inspection;

- ceramic terminal should be free of arcing, carbon tracking and cracks

2, The grommet seal should be free of :

- flashover and carbon tracking

3, The wire insulation should remain :

- flexible with no evidence of arcing through the insulation

4, Inspect the complete system for :

- security of component mounting, shorts or high voltage arcing, and loose connections.

Check System Operation

The igniter can be checked by listening for a:

- snapping noise as the engine begins to turn, driven by the starter.

The igniter can also be checked by:

- removing it and activating the start cycle, noting the spark across the igniter.

CAUTION: The high energy level and voltage associated with turbine ignition systems can cause injury or death to personnel coming into contact with the activated system

REMOVAL, MAINTENANCE AND INSTALLATION OF IGNITION SYSTEM COMPONENTS

These instructions are appl icable to the:

- engine ignition components
- Always consult the applicable manufacturer's instructions before performing any ignition system maintenance.

Ignition System Leads:

1, Remove clamps securing ignition leads to engine

2, Remove safety wire and disconnect electrical connectors from exciter units

3, Remove safety wire and disconnect lead from igniter plug.

4, Discharge any electrical charge stored in the system by grounding and remove ignition leads from engine.

5, Clean leads with approved dry cleaning solvent

6, Inspect connectors for:

- damaged threads
- corrosion
- cracked insulators
- bent or broken connector pins

7, Inspect leads for:

- worn or burned areas
- deep cuts
- fraying
- general deterioration

8, Perform continuity check of ignition leads

9, Reinstall leads, reversing the removal procedure.

Igniter Plugs:

1, Disconnect ignition leads from igniter plugs

good procedure to perform before disconnecting the ignition lead is to :

- disconnect the low voltage primary lead from the ignition exciter unit and wait at least one minute to permit the stored energy to dissipate before disconnecting the high voltage cable from the igniter

2, Remove igniter plugs from mounts

3, Inspect : igniter plug gap surface material

Before inspection:

- remove residue from the shell exterior using a dry cloth

Do not remove any:

- deposits or residue from the firing end of the low voltage igniter's.

High voltage igniter's can have:

- the firing end cleaned to aid in inspection

4, Inspect for fretting of igniter plug shank

5, Replace an igniter plug whose surface is:

- granular
- chipped
- otherwise damaged

6, Replace dirty or carbonized igniter plugs

7, Install igniter plugs in mounting pads

8, Check for proper clearance between:

- chamber liner and igniter plug.

9, Tighten igniter plugs to manufacturer's specified torque.

10, Safety wire igniter plugs